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945A

Wide-Range Ion Chamber Area Monitor

The 945A is a wide-range area monitoring system with a detectable range of 10^{-1} to 10^7 mR/h. The system is comprised of a 977-210 Wide Range Ion Chamber Detector, with local preamplifier, and a 946A-200 Universal Digital Ratemeter (UDR). The detector and preamplifier are connected by two 5-foot cables, encased in a flexible conduit. Other cable lengths, up to 100 feet between preamplifier and detector, are available. Both the detector and preamplifier are wall mounted in an area designated by the customer. The 946A-200 UDR is mounted in a rack in the control room.

Area monitors are used for the detection of x-ray or gamma radiation in selected areas. The monitor should be used in any location where personnel may be exposed to an adverse amount of radiation. Applications include nuclear reactors, accel-

erators, hot cells, irradiators and any area where radiation sources are handled. These monitors can be used as single-channel monitors or grouped together as a multichannel area monitoring system.

Detector

The 977-210 Wide Range Ion Chamber Detector is a gamma-sensitive radiation detection

device that measures radiation in the range of 10^{-1} mR/h to 10^7 mR/h with an energy dependence of less than $\pm 10\%$ from 55 keV to 3 MeV. The preamplifier is housed in a gasket-sealed enclosure. Interconnection between the detector and preamplifier is accomplished via two five-foot cables encased in a flexible conduit.



Key features

- Range: 10^{-1} to 10^7 mR/h
- Energy response: 10% from 55 keV to 3 MeV
- Life expectancy: up to 10^7 rads if preamplifier is remote or shielded
- No external power is needed at detector location
- Three twisted-pair cables with ground conductor and overall shield between detector and ratemeter for maximum noise immunity
- Environmentally hardened for operation in moisture laden environments
- Seismically tested with high reliability
- Microprocessor controlled



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The wide-range ion chamber detector design includes a dual, concentric ion chamber with a volume of approximately 1000 cc. The chamber walls are made of tissue equivalent plastic. An aluminum outer wall is provided to protect the ion chamber and to mechanically interface with the 848-8 Field Test Source. The ion chamber is biased at a nominal 500 V and produces an output current proportional to radiation absorbed in the chamber. The current is approximately 8×10^{-11} A/R/h.

The ion chamber assembly makes use of a double seal design, where the actual ion chamber is filled with nitrogen at atmospheric pressure. The connector area is sealed against moisture and particulates through the use of a sealed, liquid-tight flexible conduit between the detector and pre-amplifier electronics.

Preamplifier

The preamplifier contains a microprocessor controlled, auto-zeroing, integrating electrometer, a programmable gain amplifier, an analog-to-digital converter, an asynchronous serial communication interface, an electronic check source and the detector high voltage power supply. Communications with the UDR is accomplished via the optically isolated serial communication loop driver/receiver circuitry.

Universal Digital Ratemeter

Standard features for the instrument consist of a three-digit display of the radiation value and a multicolored bargraph indicator covering the entire

range of the detector. The bargraph changes color in the event of an alarm condition (green for normal, amber for warning and red for high). Front-panel alarm indicators and rear-panel output relay contacts for alarm annunciation are also included. Front-panel pushbuttons are provided to apply power, to display alarm limit setpoints, for alarm acknowledgment and for the activation of a check source function.

Technical specifications

Detector (977)

Detector type
Ionization chamber

Detector volume
Approximately 1000 cc

Detector constant
Approximately 8×10^{-11} A/R/h

Detector capacitance
30 picofarads nominal

Inner chamber gas
Dry nitrogen @ atmospheric pressure

Radiation detected
Gamma rays and x-rays

Range
 10^{-1} to 10^7 mR/h

Typical energy dependence
+ 10% from 55 keV to 3 MeV

Detector accuracy
+ 15% of true dose for ^{137}Cs

Power requirements
Approximately 500 V dc; high voltage level verified through autocheck routine

Check source
Electronic check source actuated from UDR front panel

Dimensions (*w x d x h*)
10.2 in x 10.25 in x 11.31 in
(25.91 cm x 26.04 cm x 28.73 cm)

Housing material
Aluminum outer chamber protective cover; inner chambers are conductive, tissue equivalent, plastic

Weight
11 lb (5 kg)

Environmental

- Operating temperature: 0 to 130 °F (-16 °C to 54 °C)
- Storage temperature: 0 to 130 °F (-16 °C to 54 °C)
- Relative humidity: 0 to 95 %, non-condensing
- Maximum external pressure: 15 psig

Preamplifier

Housing material
Carbon steel, NEMA 4 type (stainless steel available).

Interconnecting cable detector to preamplifier
Approximately five feet of signal and high voltage built-in cable contained within a flexible conduit (other lengths, up to 100 feet, available).
Interconnecting cable preamplifier to ratemeter Serial interface to 946A UDR through 942-200-80 Communication Board. Capable of driving up to 3000 feet of cable at 4800 baud, seven conductors, 16 AWG, for maximum preamplifier/ratemeter distance, excluding local alarm requirements; optional cables available on a per-foot basis.



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Power requirements

- + 15 V dc @ 250 mA,
- - 15 V dc @ 50 mA

Auxiliary alarm output

- 12 V dc @ 150 mA (max)

Auxiliary analog output

0 to 10 V dc, 2 k ohms (min)

Dimensions (*w x d x h*)

9.38 in x 4.36 in x 11.5 in
(23.83 cm x 11.07 cm x 29.21 cm)

Weight

12 lb (5.4 kg)

Environmental

- Operating temperature: 0 to 130 °F (-16 °C to 54 °C)
- Storage temperature: 0 to 130 °F (-16 °C to 54 °C)
- Relative humidity: 0 to 95 %, non-condensing
- Life expectancy: Approximately 104 rads with no external shielding

Universal Digital Ratemeter (946A-200)

Main display

Three digits with backlighted radiation units display and floating decimal point. Three digits plus exponent for data entry/display.

Bargraph display (dynamic range)

Three segments per decade. 10^{-1} to 10^7 mR/h (24 segments), tricolor, indicating channel status.

Alarm indicators

HIGH (red LED), WARN (amber LED), FAIL (red LED) and RANGE (red LED). HIGH and WARN LED's flash until acknowledged.

Alarm delay

Three minute alarm mute on channel power-up

Pushbuttons

- Setpoints: HIGH-High Alarm limit, WARN-Warn Alarm limit
- Check source: Activates electronic Check Source and associated green LED indicator. "Latching" pushbutton operation with timed automatic shut off
- Alarm acknowledgment: Causes alarm indicators to go to a steady on state after acknowledgment
- Power ON/OFF: Alternate action pushbutton for ac power to the unit

Relay outputs

(fail-safe operation)

- High alarm: One set. DPDT rated 5 A @ 120 V ac (one set 120 V ac powered for use with optional remote alarm)
- Warn alarm: Two sets. DPDT rated 5 A @ 120 V ac
- Fail alarm: Two sets. DPDT rated 5 A @ 120 V ac
- Contact rating for all relays is 5 A @ 28 V dc

Analog outputs

4 to 20 mA (2) (500 ohms max) and 0 to 10 V dc (1 k-ohm min), logarithmic. May be scaled for any one decade (min) to the full range of the unit (max).

Alarm acknowledgment input

Optically isolated dc input.

Accuracy (electronic)

$\pm 1\%$ digit ($\pm 1\%$ of the displayed value), exclusive of the detector energy response.

Dimensions (*w x d x h*)

5.64 in x 13.73 in x 3.47 in
(14.33 cm x 34.87 cm x 8.81 cm)

Weight

4 lb (1.8 kg)

Power requirements

120 V ac $\pm 10\%$, 50/60 Hz, 28 W (240 V ac optional)

Environmental

- Operating temperature: 32 °F to 122 °F (0 to 50 °C)
- Storage temperature: 32 °F to 122 °F (0 to 50 °C)
- Relative humidity: 0 to 95 %, non-condensing

Heat loading

Approximately 96 BTU/hr

Compatible detectors

977 Series Wide Range Ion Chamber Detectors

Field Test Source (848-8)

Description

Portable, fixed geometry, test fixture for on-site testing of the 977 Series Ion Chamber Detector

Dimensions (*w x d x h*)

8.88 in x 13.25 in x 6.63 in
(22.5 cm x 33.6 cm x 16.8 cm)

Weight

24 lb (11 kg)

Radioactive source

100 mCi, ¹³⁷Cs (optional 10, 20 and 1 mCi sources available)

External radiation levels (with 100 mCi source)

- Closed position: < 5 mR/h at a distance of 1 ft
- Open position: 100 mR/h at 2 ft

Internal radiation levels (with 100 mCi source)

- Closed position: 50 mR/h
- Intermediate position: 500 mR/h
- Open position: 5,000 mR/h

Rack Chassis (948-1)

Description

Mounts the 946A UDR in a 19-inch wide unit control room panel or cabinet. Each rack chassis may accommodate 3 UDRs. The 948A-2 panel is available to fill unused positions.

Dimensions (*w x d x h*)

19.00 in x 14.80 in x 3.47 in
(48.26 cm x 37.59 cm x 8.81 cm)

Weight

10 lb (4.5 kg)

Ordering information

Model

945A: Wide-Range Ion Chamber Area Monitor

Component parts

977-210: Wide-Range Ion Chamber Detector with local preamplifier Detector

946A-200: Universal Digital Ratemeter

Optional accessories

848-8: Field Test Source

948-1: Rack Chassis



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